II. AMENDMENTS TO THE CLAIMS:

Please cancel claims 15-17, 19 and 24 without prejudice. Kindly amend claims 1-3, 10, 12, 18, 20-23 and 25 as follows.

The following Listing of Claims replaces all prior listings, or versions, of claims in the above-captioned application.

LISTING OF CLAIMS:

1. (Currently Amended) A multi-step method for abrupt water hammerless opening of a fluid passage, the method comprising the steps of:

(a) providing a fluid passage openable by operation of an actuator operating type valve provided on the fluid passage of a pipe passage, wherein the fluid passage has a nearly constant pressure inside the pipe passage;

(b) detecting a vibration detecting signal Pr from vibration of the pipe passage caused by a change of internal pressure of the pipe passage;

(c) moving a valve body of the actuator operating type valve from a state of full valve closing in a direction of valve opening to a first degree of valve opening by increasing driving input to an actuator of the actuator operating type valve, wherein the driving input is increased to a first prescribed set value sufficient~~in order~~ to prevent a water hammer in the fluid passage, wherein the first prescribed set value is a step pressure setting signal Ps wherein the vibration detecting signal Pr does not exceed a permissible upper limit vibration setting signal Prm;

(d) holding the driving input to the actuator at the first set value for a first period of time; and then

(e) further increasing the driving input to move the valve body from the first degree of valve opening to a state of full valve opening so the fluid passage is opened without causing a water hammer, and wherein the valve body of the actuator operating type valve is moved from the state of full valve closing to the state of full valve opening in only two steps, or only three steps, or only four steps.

2. (Currently Amended) A multi-step method for abrupt water hammerless opening of a fluid passage as claimed in Claim 1, wherein the valve is a normally closed and pneumatic pressure operating type diaphragm valve, wherein the diaphragm valve is a fixed capacity type diaphragm valve wherein an inner capacity of the diaphragm valve is fixed and does not change when the valve is operated.

3. (Currently Amended) A multi-step method for abrupt water hammerless opening of a fluid passage as claimed in Claim 1, wherein the first period of time is less than 1 second, and a pressure rise value of the fluid passage is made to be within 10% of a first steady state pressure value before opening the valve.

4. (Withdrawn) A device for water hammerless opening of a fluid passage, comprising:

(a) a valve comprising a valve body;

(b) an actuator disposed to drive the valve body;

(c) a vibration sensor removably fixed to a pipe passage on an upstream side of the valve;

(d) an electro-pneumatic conversion control device disposed to receive a valve opening/closing command signal input, wherein the electro-pneumatic conversion control

device comprises a data storage part, wherein an actuator operating pressure Pa inputted to the actuator is controlled by a control signal Sc stored in advance in the data storage part; and

(e) a computation control device comprising a comparison computation circuit, wherein the comparison computation circuit is disposed to receive as input a vibration detecting signal Pr from the vibration sensor, a step pressure setting signal Ps to be supplied to the actuator, a step pressure holding time setting signal Ts, and a permissible upper limit vibration pressure setting signal Prm, and wherein the comparison computation circuit compares the vibration detecting signal Pr and the permissible upper limit vibration pressure setting signal Prm, and the step pressure setting signal is adjusted by the comparison computation circuit so that the control signal Sc is outputted by the comparison computation circuit to the data storage part of the electro-pneumatic conversion control device, wherein the control signal Sc comprises the holding time setting signal Ts and the adjusted step pressure setting signal Ps.

5. (Withdrawn) A device for water hammerless opening of a fluid passage as claimed in Claim 4, wherein the computation control device further comprises a step pressure setting circuit, a holding time setting circuit, a permissible upper limit vibration pressure setting circuit, a vibration pressure detecting circuit and the comparison computation circuit; and when the vibration detecting signal Pr exceeds the permissible upper limit vibration pressure setting signal Prm immediately after an actuator operating signal is step-changed, the step pressure setting signal Ps is adjusted toward a rising direction, and when the vibration detecting signal Pr exceeds the permissible upper limit vibration pressure setting signal Prm immediately after the actuator operating pressure Pa is made to zero from the intermediate

step operating pressure, the step pressure setting signal Ps is adjusted toward a lowering direction.

6. (Withdrawn) A device for water hammerless opening of a fluid passage as claimed in Claim 4, wherein the electro-pneumatic conversion device comprises the data storage part that stores the control signal Sc from the computation control device, a signal conversion part, and an electro-pneumatic conversion part, wherein an actuator operating pressure control signal Se is outputted from the signal conversion part to the electro-pneumatic conversion part based on a control signal Sc' stored in advance in the data storage part so that the pipe passage is opened without causing a water hammer.

7. (Withdrawn) A device for water hammerless opening of a fluid passage, comprising:

(a) an actuator operating type valve installed on a fluid passage;

(b) an electro-pneumatic conversion device disposed to supply a 2-step actuator operating pressure Pa to the actuator operating type valve;

(c) a vibration sensor removably fixed to the pipe passage on an upstream side of the actuator operating type valve; and

(d) a tuning box disposed to receive as input a vibration detecting signal Pr detected through the vibration sensor and to output to the electro-pneumatic conversion device a control signal Sc to control a step operating pressure Ps' of the 2-step actuator operating pressure Pa, wherein the tuning box adjusts the control signal Sc so that output from the electro-pneumatic conversion device of the 2-step actuator operating pressure Pa comprising the step operating pressure Ps' makes the vibration detecting signal Pr nearly zero.

8. (Cancelled)

9. (Cancelled)

10. (Currently Amended) A multi-step method for water hammerless opening of a fluid passage as claimed in Claim 18, wherein the vibration sensor and the tuning box are removeable, and are removed after the control signal data at a time of outputting the second 2-step operating pressure, with which generation of vibration is nearly zero, are inputted to a memory storage of the electro-pneumatic conversion device.

11. (Previously Presented) A multi-step method for water hammerless opening of a fluid passage as claimed in Claim 18, wherein the vibration sensor is provided at a position on the upstream side within 1000mm from where the actuator operating type valve is installed on the fluid passage.

12. (Currently Amended) A multi-step method for water hammerless opening of a fluid passage as claimed in Claim 18, wherein a step operating pressure holding time t of the second 2-step operating pressure is set at less than 1 second.

13. (Withdrawn) A method for supplying a chemical solution, comprising the steps of:

(a) supplying a fluid to a fluid passage on a downstream side of an actuator operating type valve installed on the fluid passage by opening the fluid passage using the actuator operating type valve, wherein the fluid passage has a nearly constant internal pressure therein, and the fluid is a chemical solution; wherein opening of the fluid passage includes the steps of

i. firstly, moving a valve body of the actuator operating type valve toward a direction of valve opening by increasing or decreasing a driving input to an actuator to the prescribed set value, wherein the actuator is operably connected to the actuator operating type valve; and

ii. secondly, holding the actuator driving input at the set value for a first period of time; and

thirdly, further increasing or decreasing the driving input to move the valve body of the valve to a state of full opening so that a water hammer does not occur at the time the valve is opened.

14. (Withdrawn) A method for supplying a chemical solution as claim in Claim 13, wherein the first period of time is less than 1 second.

15. (Cancelled)

16. (Cancelled)

17. (Cancelled)

18. (Currently Amended) A multi-step method for water hammerless opening of a fluid passage, the method comprising the steps of:

(a) providing a fluid passage openable by operation of an actuator operating type valve provided on the fluid passage of a pipe passage, wherein the fluid passage has a nearly constant pressure inside the pipe passage;

(b) moving a valve body of the actuator operating type valve toward a full valve opening state by increasing driving input to an actuator of the actuator operating type valve,

wherein the driving input is increased to a first prescribed set value thereby partially opening the actuator operating type valve;

(c) holding the driving input to the actuator at the first set value for a first period of time; and then

(d) further increasing the driving input to move the valve body to the state of full valve opening so the fluid passage is opened, wherein the fluid passage has a vibration sensor removably fixed on an upstream side of the actuator operating type valve installed on the fluid passage;

(e) inputting a vibration detecting signal Pr from the vibration sensor to a tuning box when opening the fluid passage; and then,

(f) inputting a first control signal from the tuning box to an electro-pneumatic conversion device; and

(g) generating a first 2-step actuator operating pressure in the electro-pneumatic conversion device when the first control signal is inputted, wherein the first 2-step actuator operating pressure includes a first step actuator operating pressure, an initial intermediate step operating pressure, and a second step actuator operating pressure, and a final step operating pressure, and supplying the first 2-step actuator operating pressure to the actuator operably connected to the actuator operating type valve so that the actuator operating type valve is made to open in a 2-step operation, wherein the first 2-step actuator operating pressure to be supplied to the actuator and the vibration detecting signal are compared for a relative relationship of the two, and

i. when vibration is generated at a time when thea first step actuator operating pressure rises so the first step actuator operating pressure is equal to the initial intermediate step operating pressure, then the initial intermediate step operating

pressure of the first 2-step operating pressure is adjusted so that the initial intermediate step operating pressure is lowered to form a corrected intermediate step operating pressure that is determined so as to decrease the vibration detecting signal Pr;~~,~~ and

ii. when vibration is generated at a time when the~~a~~ second step actuator operating pressure rises so that the second step actuator operating pressure rises from the initial intermediate step operating pressure to the final step operating pressure, then the initial intermediate step operating pressure of the first 2-step operating pressure is adjusted so that the initial intermediate step operating pressure is raised to form the corrected~~, so that a second~~ intermediate step operating pressure that is determined so as to decrease~~make~~ the vibration detecting signal Pr~~ nearly zero~~,

wherein a~~the~~ second intermediate step operating pressure is determined by repeating a plurality of preliminary adjustments of raising or lowering corrected intermediate step operating pressure so that the actuator operating type valve is made to open based on second control signal data that corresponds to a second 2-step operating pressure that includes the second intermediate step operating pressure, wherein the second control signal data is then inputted to the electro-pneumatic conversion device to control movement of the valve body without causing a water hammer because generation of vibration in the fluid passage is nearly zero, and the vibration detecting signal Pr is nearly zero.

19. (Cancelled)

20. (Currently Amended) A multi-step method for abrupt water hammerless opening of a fluid passage as claimed in Claim 1, wherein the fluid passage is opened from the state of full valve closing to the state of full valve opening within 300 to 1000 msec without causing a water hammer.

21. (Currently Amended) A multi-step method for abrupt water hammerless opening of a fluid passage, the method comprising the steps of:

(a) providing a fluid passage openable by operation of an actuator operating type valve provided on the fluid passage of a pipe passage, wherein the fluid passage has a nearly constant pressure inside the pipe passage;

(b) detecting a vibration detecting signal Pr from vibration of the pipe passage caused by a change of internal pressure of the pipe passage;

(c) moving a valve body of the actuator operating type valve from a state of full valve closing in a direction of valve opening to a first degree of valve opening by decreasing driving input to an actuator of the actuator operating type valve, wherein the driving input is reduced to a first prescribed set value sufficient~~in order~~ to prevent a water hammer in the fluid passage, wherein the first prescribed set value is a step pressure setting signal Ps wherein the vibration detecting signal Pr does not exceed a permissible upper limit vibration setting signal Prm;

(d) holding the driving input to the actuator at the first set value for a first period of time; and then

(e) further decreasing the driving input to move the valve body from the first degree of valve opening to a state of full valve opening so the fluid passage is opened without

causing a water hammer, and wherein the valve body of the actuator operating type valve is moved from the state of full valve closing to the state of full valve opening in only two steps, or only three steps, or only four steps.

22. (Withdrawn and Currently Amended) A multi-step method for abrupt water hammerless opening of a fluid passage as claimed in Claim 1, wherein the valve is a normally open and pneumatic pressure operating type diaphragm valve, wherein the diaphragm valve is a fixed capacity type diaphragm valve wherein an inner capacity of the diaphragm valve is fixed and does not change when the valve is operated.

23. (Currently Amended) A multi-step method for abrupt water hammerless opening of a fluid passage as claimed in Claim 21, wherein the fluid passage is opened from the state of full valve closing to the state of full valve opening within 300 to 1000 msec without causing a water hammer.

24. (Cancelled)

25. (Currently Amended) A multi-step method for water hammerless opening of a fluid passage, the method comprising the steps of:

(a) providing a fluid passage openable by operation of an actuator operating type valve provided on the fluid passage of a pipe passage, wherein the fluid passage has a nearly constant pressure inside the pipe passage;

(b) moving a valve body of the actuator operating type valve toward a full valve opening state by decreasing driving input to an actuator of the actuator operating type valve, wherein the driving input is decreased to a first prescribed set value thereby partially opening the actuator operating type valve;

(c) holding the driving input to the actuator at the first set value for a first period of time; and then

(d) further decreasing the driving input to move the valve body to a state of full valve opening so the fluid passage is opened, wherein the fluid passage has a vibration sensor removably fixed on an upstream side of the actuator operating type valve installed on the fluid passage;

(e) inputting a vibration detecting signal Pr to a tuning box when opening the fluid passage; and then,

(f) inputting a first control signal from the tuning box to an electro-pneumatic conversion device; and

(g) generating a first 2-step actuator operating pressure in the electro-pneumatic conversion device when the first control signal is inputted, wherein the first 2-step actuator operating pressure includes a first step actuator operating pressure, an initial intermediate step operating pressure, and a second step actuator operating pressure, and a final step operating pressure, and supplying the first 2-step actuator operating pressure to the actuator operably connected to the actuator operating type valve so that the actuator operating type valve is made to open in a 2-step operation, wherein the first 2-step actuator operating pressure to be supplied to the actuator and the vibration detecting signal Pr are compared for a relative relationship of the two, and

i. when vibration is generated at a time when thea first step actuator operating pressure drops so the first step actuator operating pressure is equal to the initial intermediate step operating pressure, then the initial intermediate step operating pressure of the first 2-step operating pressure is adjusted so that the initial intermediate step operating pressure is raised to form a corrected intermediate step operating pressure that is determined so as to decrease the vibration detecting signal Pr;~~,~~ and

ii. when vibration is generated at a time when thea second step actuator operating pressure drops so that the second step actuator operating pressure drops from the initial intermediate step operating pressure to the final step operating pressure, then the initial intermediate step operating pressure of the first 2-step operating pressure is adjusted so that the initial intermediate step operating pressure is lowered to form the corrected~~, so that a second~~ intermediate step operating pressure that is determined so as to decrease~~make~~ the vibration detecting signal Pr~~ nearly zero~~, wherein a~~the~~ second intermediate step operating pressure is determined by repeating a plurality of preliminary adjustments of raising or lowering corrected intermediate step operating pressure so that the actuator operating type valve is made to open based on second control signal data that corresponds to a second 2-step operating pressure that includes the second intermediate step operating pressure, wherein the second control signal data is then inputted to the electro-pneumatic conversion device to control movement of the valve body without causing a water hammer because generation of vibration in the fluid passage is nearly zero, and the vibration detecting signal Pr is nearly zero.